gametophyte proceeds as usual, filling the sac with primary endosperm cells, in which free nuclear division occurs before cross-walls form the permanent tissue. The archegonia are usually four in number, and a distinct ventral canal cell is cut off, the membrane persisting until fertilization occurs. The proembryo is the usual one of Abietineae, walls appearing at the eight-nucleate stage, and four tiers of cells being organized, the uppermost tier being open.—J. M. C.

Embryo sac of Pandanus.—CAMPBELL[32] has published the details of the development of the embryo sac of this interesting form, the preliminary account having been published last year.[33] The stage showing fertilization was not obtained, so that it is not certain that the fourteen-nucleate condition described is the fertilization stage. The megaspore mother cell is overlaid by several layers of parietal cells, which are thought to be derived from a single cell. The division of the mother cell is followed by the direct production of the embryo sac by the inner daughter cell. At the first division, the two nuclei assume the polar positions, and subsequent divisions result in two micropylar nuclei and twelve antipodal nuclei. If two megaspore nuclei are supposed to enter into the structure of this sac, there is a single division of one of them, and a succession of divisions from the other one. From any point of view, such a sac would be unusual, and the author is inclined to regard it as "a new type with its nearest analogue in Peperomia," a type which is probably more ancient than the prevailing eight-nucleate sac. He dissents from the idea that the reduction division necessarily determines a megaspore in angiosperms, believing that this event may so shift in the life-history that a megaspore may be defined regardless of it. After all, this is merely a matter of definition, and that is a matter of agreement. Shall a megaspore be defined as the product of the two reduction divisions or as the cell which produces the embryo sac? Which definition will have the greater morphological stability?—J. M. C.

Diffusion of CO_2 in leaves.—That CO_2 does not diffuse extensively through the mesophyll has been known for more than thirty years from the researches of MOLL, and experiments to show the localization of photosynthesis have become common in every physiological laboratory. Under MOLL's direction, ZIJLSTRA has investigated the extent of diffusion in leaves of different structures.[34] He finds that in all leaves the CO_2 formed in the leaf itself suffices to produce a line or zone of starch at the edge of the darkened region. In net-veined leaves the movement of CO_2 supplied from the air is prevented by the larger veins which

[32] CAMPBELL, D. H., The embryo sac of Pandanus. Bull. Torr. Bot. Club **36**:205–220. *pls. 16, 17.* 1909.

[33] CAMPBELL, D. H., The embryo sac of Pandanus. Preliminary note. Annals of Botany **22**:330. 1908.

[34] ZIJLSTRA, K., Kohlensäuretransport in Blättern. Proefschrift ter verkrijging aan der graad van Doctor in plant- en dierkunde aan der Rijks-Universiteit te Groningen. . . . . 8vo. pp. 128. *pls. 2. figs. 2.* Groningen: M. de Waal. 1909.

stretch from surface to surface without intercellular spaces. Consequently the width of the lines of starch produced at the edge of the darkened region is not widened even though the unlighted area is supplied with CO_2 under abnormal pressure. If the net be coarse the zone of marginal starch will be wider than if it is fine. Diffusion of self-produced CO_2 to 2.5^{cm} at most is thus possible; for in parallel-veined leaves of Triticum, Hordeum, and Zea, though the veins do not prevent diffusion, the intercellular passages are so narrow as to limit it to 3^{cm}. In Tradescantia and Acorus the transverse anastomoses prevent more extensive movement. In Eichhornia, Pontederia, and Eucomis the leaves have spacious intercellular passages, and so the movement is much more free. But even here the diffusion scarcely surpasses 3^{cm}, unless through a region of the leaf that is not in condition to act on the CO_2. In nature, therefore, movement of CO_2 may be considered practically nil.—C. R. B.

Seedling of a graft-hybrid.—Certain branches of the graft hybrid, *Cytisus Adami*, revert, producing flowers having the characters of the reputed parents *C. Laburnum* and *C. purpureus* respectively. The *C. Adami* flowers are ordinarily sterile, while those borne on reverted branches reproduce their respective parents.

In May, 1904, HILDEBRAND[35] observed that several flowers of a *C. Adami* branch of a cultivated specimen in the Freiburg botanical garden had set seed, and was able to obtain three fruits from them, which had chiefly the characters of *C. Laburnum*, but in certain respects resembled *C. purpureus*. It is not known whether these flowers were self-pollinated, but it is not unlikely that the pollen came from *C. Laburnum* flowers, since the *C. Adami* flowers are usually sterile. Two of the seeds germinated. Both were very similar in character to *C. Laburnum* and in 1907 one of them produced hundreds of flowers, all having the characters of *C. Laburnum*. No conclusions can be drawn regarding the hereditary bearing of these facts, in the absence of a knowledge of the manner of pollination of the flowers and the nature of the next generation of offspring.—R. R. GATES.

Chlorophyll.—The discussion as to the phosphorus content of chlorophyll waxes warm. STOKLASA replies vigorously[36] to TSWETT'S criticisms[37] and takes issue with WILLSTÄTTER'S results.[38] The question is yet in the stage of polemic

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[35] HILDEBRAND, FRIEDRICH, Ueber Sämlinge von *Cytisus Adami*. Ber. Deutsch. Bot. Gesells. **26a**:590–595. 1908.

[36] STOKLASA, J., BRALIK, V., UND ERNST, A., Zur Frage des Phosphorgehaltes des Chlorophylls. Ber. Deutsch. Bot. Gesells. **27**:10–20. 1909.

[37] TSWETT, M., Ist der Phosphor an dem Anbau des Chlorophylline beteiligt? *Ibid.* **26a**:214–220. 1908.

[38] WILLSTÄTTER, R., Zur Kenntniss der Zusammensetzung des Chlorophylls. Liebig's Annalen der Chemie **350**:48–82. 1906.

WILLSTÄTTER, R., UND BENZ, M., Ueber krystallisiertes Chlorophyll. *Ibid.* **358**: 267–287. 1907.